5876)
U7R6
77-12

Forest Insect and Disease Management

5230
BIOLOGICAL
EVALUATION R2-77-12

MOUNTAIN PINE BEETLE

Black Hills of South Dakota
and Wyoming
Black Hills National Forest
& Adjacent State & private
Lands of South Dakota
and Wyoming

NOVEMBER 1977

Rocky Mountain Region

LIBRARY
MAR 21 1978
ROCKY MOUNTAIN STATION

U.S. Department of Agriculture Forest Service

5230
BIOLOGICAL
EVALUATION R2-77-12

MOUNTAIN PINE BEETLE

Black Hills of South Dakota
and Wyoming
Black Hills National Forest
& Adjacent State & private
Lands of South Dakota
and Wyoming

NOVEMBER 1977

PREPARED BY: Vernon L M Creasap
Vernon L. M. Creasap
Entomologist

APPROVED BY:

G L Downing
G. L. DOWNING
Staff Director
Forest Insect and Disease Management

F. A. Dorrell
F. A. DORRELL
Deputy Regional Forester
State and Private Forestry

Forest Insect and Disease Management
State and Private Forestry
Rocky Mountain Region
USDA Forest Service
11177 W. 8th Avenue
Lakewood, Colorado 80225

INTRODUCTION

Ponderosa pine mortality from the mountain pine beetle (MPB) continues to be heavy in the Black Hills of South Dakota and Wyoming. Although losses are still high, mortality appears to have decreased from 1976. It was estimated that approximately 660,000 ponderosa pine were killed by the MPB in 1976 (Creasap and Minnemeyer, 1976). Aerial sketch mapping and photo interpretation indicated that there were 300,000 to 350,000 1976 killed pine remaining after beetle control efforts.

An aerial survey was conducted to map and photograph the MPB population in the Black Hills. The photographs were taken as part of an experimental damage study for determining volume lost to the MPB. This study was undertaken in cooperation with the Forest Service, Methods Application Group, Davis, California. Sixty 2.5-acre plots were randomly selected from the aerial photos and surveyed on the ground, in order to determine the accuracy of the photo-interpretation used to determine timber loss. Data were taken on the 2.5-acre plots to determine build-up ratio. Five variable point prism plots were also taken on each of these plots in order to determine stand composition. After the 2.5-acre plots were completed it was found that insufficient data had been gathered for a statistically sound estimate of the build-up ratio. Another trip was made to the Black Hills to run one-chain-wide by one-mile long strip cruises in order to pick up the needed data. Build-up ratio data indicates that there is an overall decrease in tree mortality for the Black Hills. The ratio of 1976-infested trees to 1977-infested trees averaged 1 : 0.73. Salvage logging, piling and burning, and drenching felled trees with ethylene dibromide removed approximately 330,900 infested ponderosa pine in 1977, on Federal, Wyoming State, South Dakota State, and private lands.

TECHNICAL INFORMATION

CAUSAL AGENT: *Dendroctonus ponderosae* Hopkins, mountain pine beetle

HOST: *Pinus ponderosa* Laws., ponderosa pine

LIFE HISTORY: The mountain pine beetle has one generation per year. Adults attack trees during August and early September by boring through the bark to the cambium, then tunnel upward for 12 to 30 inches (these tunnels are called egg galleries). The females lay eggs in individual niches along each side of the gallery which is then packed with frass. After hatching, the larvae feed in individual channels (larval galleries), at right angles to the egg gallery, in the phloem. The insect overwinters in the larval stage. In the spring, when the larvae are fully developed they excavate an oval chamber (pupal chamber) at the end of the larval gallery and pupate. Finally mature adults emerge from these pupal chambers by boring through the outer bark surface and fly to attack new trees, completing the generation.

METHODS

Sixty, 2.5-acre plots were randomly selected from a grid overlay of aerial photos of the mountain pine beetle infestation in the Black Hills. The plots were etched on the photos and, 1976 and previously infested ponderosa pines within the plots were counted. Field crews then located the 2.5-acre plots on the ground in order to check the photo-interpreters mortality estimate. A count of 1977- and 1976-infested ponderosa pines within the 2.5-acre plot was made to determine the build-up ratio of 1976 to 1977 infested trees. Five variable point prism plots were taken on each 2.5-acre plot to determine the stand composition. After the photo plots were finished it was found that insufficient data had been collected to obtain a statistically sound build-up ratio, so 13 one-chain-wide by one-mile-long strip cruise lines were run in order to obtain sufficient data for a statistically reliable build-up ratio. Variable point prism plots were run at five-chain intervals along the strip line in order to gain additional stand composition data.

RESULTS

Aerial and ground surveys in the fall indicated a decrease in mountain pine beetle activity over 1976. The ratio of 1976-infested to 1977-infested ponderosa pines was 1 : 0.73.

By contrast, the 1977 summer mountain pine beetle brood survey indicated a static to increasing population (Cahill 1977). Most

of the Black Hills showed a static population trend. The Spearfish and Nemo Districts (in particular, the Limestone Plateau) showed a sharply decreasing trend. The differences in the trends indicated in the summer and fall surveys, could be due to further brood mortality after the summer survey and heavy adult mortality during flight season, before the fall survey.

In 1976, it was estimated that 660,000 ponderosa pines had been infested by the mountain pine beetle (Creasap and Minnemeyer 1976). It is estimated that between 220,000 and 255,000 ponderosa pine were infested in 1977.

Table 1 shows the break down of build-up ratio by ranger district, photo plot data and strip cruise data. It also summarizes the basal area of the total stand, live and dead pine and non-host tree species (spruce, oak, aspen and birch). Table 2 summarizes the average dbh of the total stand, residual stand, live infested pine, and non-host tree species. Table 2 also summarises how average dbh of the stands is being reduced by MPB losses. Table 3 is a summary of the stand composition from the variable plot data. Table 4 gives the map symbol identification for the photo plots (numbered) and strip cruise lines (lettered). The letter symbols for the strip cruise lines are also used in Tables 2 and 3. Figure 1 shows the locations of the 60 photo plots and the 13 strip cruise lines.

The 1977 mortality from mountain pine beetle is reduced from 1976. This reduction is probably due in part to the dry winter. Mountain pine beetle larval mortality was noted to be higher above the apparent snow line where the trees had dried out more than below the snow line (Cahill 1977). Removal of infested trees by piling and burning and salvage logging and chemical treatment of infested trees also helped to reduce the beetle population. The combination of all mortality factors helped reduce the ponderosa pine mortality during 1977.

There are several alternative approaches for controlling MPB populations in ponderosa pine stands.

ALTERNATIVES

Alternative 1: Reduce the growing stock level of all operable stands to 80 to 90. This will effectively reduce the susceptibility of stands to mountain pine beetle attack for periods of 20 years or more. Uneven age stand management often requires partial cutting in stands every 10 or 20 years. Therefore, the reduction of growing

stock levels to 80 to 90, with subsequent expected protection of the stand from beetle attack for 20 years or more, agrees with current timber management techniques.

Alternative 2: Salvage dying and dead timber. This action will not reduce the susceptibility of the stands to mountain pine beetle attack since the stands may become reinfested within a few years. Salvage logging will remove dead and dying trees which could be considered less aesthetically pleasing. Salvage logging should only be used in areas where the residual stand will receive silvicultural treatment within 3 to 5 years. Salvage logging alone is only a temporary measure to reduce beetle populations and cannot be expected to provide protection to a stand for more than 3 to 5 years.

Alternative 3: Do nothing to alleviate the pressure of mountain pine beetle attack. This alternative cannot be justified from timber, recreation, or other resource management points of view. The mountain pine beetle, in epidemic proportions, may reduce growing stock below satisfactory levels for timber management. Dead trees will also increase fire hazard for a few years. During periods of very high or extreme fire danger, forest use may be restricted or entirely closed down during high recreational use times because of the low fuel moisture content of large amounts of available fuel. Fire may further reduce timber inventory.

Alternative 4: Direct control by chemical treatment or burning of infested timber, in a few cases in Region 2, may be an alternative. In order to use direct control a benefit/cost analysis should be done. Silviculturally or biologically, direct control cannot be justified except to buy time for silvicultural treatment. Direct control is only a temporary measure which will not protect a stand from beetle attack for more than 3 to 5 years. Furthermore, in most cases the treated trees are not utilized and no return is realized on the high investment needed for direct control.

RECOMMENDATIONS

Of the alternatives listed, number 1 is recommended as the primary tool for land managers in the Black Hills. Alternative 2 should only be used when an area is scheduled for silvicultural treatment within 3 to 5 years. Alternative 3 should be used in inaccessible

or inoperable areas where a choice of the other alternatives does not exist. At the present time, alternative 4 is not recommended. Land managers should complete a benefit/cost analysis to determine whether or not alternative 4 is feasible. The following publication will aid land managers in determining whether or not alternatives 3 or 4 should be used:

AVERILL, R. D., J. E. GUNTER, C. K. LISTER and D. H. SONNEN. 1977. Benefit/cost guidelines for bark beetle control. USDA, For. Serv. Rocky Mtn. Region. Tech. Rep. R2-11. 30 pp.

Land managers are advised to use all available information in their management plans. New information which may be useful for land managers in formulating management plans will be listed in biological evaluations and in Forest Insect and Disease Management Annual Reports.

REFERENCES

1. CREASAP, V. L. M. and C. D. MINNEMEYER. 1976. The mountain pine beetle in the Black Hills of South Dakota and Wyoming. USDA, For. Serv. Rocky Mountain Region. Forest Insect and Disease Management Biological Evaluation R2-76-8. 12 pp.

2. CAHILL, D. B. 1977. Mountain pine beetle. Black Hills of South Dakota and Wyoming. USDA, For. Serv. Rocky Mtn. Region. Forest Insect and Disease Management Biological Evaluation R2-77-5. 7 pp.

3. SARTWELL, C. and R. E. DOLPH. 1976. Silvicultural and direct control of mountain pine beetle in second growth ponderosa pine. USDA, For. Serv. Pacific Northwest Range and Experiment Station. Res. Note PNW-268. 8 pp.

TABLE 1 STRIP CRUISE - BASAL AREA SUMMARY

Area	Number of plots (Variable plots)	Number of Acres	1977 Infested Pines	1976 Infested Pines	Basal Area						
					All Trees	Live PP	Dead PP	1977 PP	1976 PP	Old PP	Other Tree Species
					Square feet per Acre						
Bear Lodge Ranger District											
Photo Plot Data											
Light Strata	1 (5)	1.8	0	0	72.00	72.00	-	-	-	-	-
Medium Strata	4 (20)	10.5	7	10	93.00	84.00	2.50	-	1.00	1.50	6.50
Heavy Strata	1 (5)	3.1	0	0	48.00	42.00	-	-	-	-	6.00
Total	6 (30)	15.4	7	10							
Average					82.00	75.00	1.67	-	0.67	1.00	5.33
Strip Cruise Data											
Ball Hill	16	8.0	23	18	90.00	81.88	6.88	0.62	2.50	3.12	1.25
Tent Canyon I	20	10.0	21	25	92.50	87.00	5.50	3.50	1.50	0.50	-
Tent Canyon II	18	9.0	29	25	111.11	103.89	7.22	3.33	1.67	1.67	-
Total	54	27.0	73	68							
Average					97.96	91.11	6.48	2.59	1.85	1.67	0.37
District Total	84	42.4	80	78							
District Average					92.26	85.36	4.76	1.67	1.43	1.43	2.14
Custer Ranger District											
Photo Plot Data											
Light Strata	3 (15)	8.2	0	0	100.67	97.33	3.33	-	-	-	-
Medium Strata	1 (5)	2.8	18	17	134.00	80.00	54.00	6.00	10.00	38.00	-
Heavy Strata	0	0.0	0	0	-	-	-	-	-	-	-
Total	4 (20)	11.0	18	17							
Average					109.00	93.00	16.00	1.50	2.50	9.50	-
Strip Cruise Data											
The Needles	12	6.0	109	159	62.50	34.17	28.33	9.17	15.83	3.33	-
District Total	32	17.0	127	176							
District Average					31.58	70.94	20.62	4.38	7.50	7.19	-
Elk Mountain Ranger District											
Photo Plot Data											
Light Strata	2 (10)	4.4	0	0	80.00	78.00	1.00	-	-	-	1.00
Medium Strata	2 (10)	6.4	0	0	104.00	101.00	-	-	-	-	3.00
Heavy Strata	0	0.0	0	0	-	-	-	-	-	-	-
Total	4 (20)	10.8	0	0							
Average					92.0	89.50	0.50	-	-	-	2.00
Strip Cruise Data											
Deer Creek	16	8.0	8	33	108.12	82.50	16.25	2.50	3.12	10.62	9.38
District Total	36	18.8	8	33							
District Average					99.17	86.39	7.50	1.11	1.39	4.72	5.28
Harney Ranger District											
Photo Plot Data											
Light Strata	3 (15)	7.0	4	5	133.33	73.33	30.00	15.00	2.00	12.00	30.00
Medium Strata	6 (30)	15.2	6	10	98.00	79.67	2.33	-	1.33	0.67	20.00
Heavy Strata	3 (15)	9.2	126	20	111.33	84.00	25.33	15.00	2.00	7.33	2.00
Total	12 (60)	31.4	136	35							
Average					110.17	77.17	15.00	8.00	1.67	5.17	18.00
Strip Cruise Data											
Bobcat Gulch	16	8.0	50	10	131.25	114.38	16.88	8.21	1.25	7.50	-
Spring Creek	16	8.0	2	22	100.00	92.50	5.62	0.62	2.50	1.25	1.88
Total	32	16.0	52	32							
Average					115.52	103.44	11.25	4.42	1.88	4.38	0.99
District Total	92	47.4	188	67							
District Average					112.07	86.30	13.70	6.74	1.74	4.89	12.07
Reno Ranger District											
Photo Plot Data											
Light Strata	5 (25)	14.6	15	7	87.20	78.80	1.20	-	0.80	0.40	7.20
Medium Strata	3 (15)	7.5	12	12	128.67	114.00	5.00	1.33	0.67	1.33	8.67
Heavy Strata	3 (15)	9.2	95	78	65.33	52.67	12.00	10.67	1.33	-	0.67
Total	11 (55)	31.3	122	97							
Average					92.55	81.27	5.45	3.27	1.09	0.56	5.82
Strip Cruise Data											
Boulder Park	17	8.0	27	141	132.35	98.82	13.23	10.00	14.71	4.12	4.71
East Spearfish Creek	20	10.0	13	37	86.00	66.50	8.00	2.00	5.00	-	11.50
Strawberry Ridge	16	8.0	127	37	148.12	93.75	31.25	11.88	8.75	19.62	23.12
Total	53	26.0	167	215							
Average					119.62	85.04	21.70	7.55	9.62	4.53	12.83
District Total	108	57.3	289	312							
District Average					105.83	83.15	13.43	5.37	5.28	2.50	9.26
Spearfish Ranger District											
Photo Plot Data											
Light Strata	6 (30)	14.8	11	73	112.67	81.00	6.00	0.33	1.67	4.00	25.67
Medium Strata	4 (20)	12.0	23	19	130.50	122.50	3.00	1.50	-	1.50	5.00
Heavy Strata	13 (65)	38.5	156	210	124.45	95.54	21.38	4.31	5.54	10.31	7.85
Total	23 (115)	66.3	190	302							
Average					122.43	96.43	14.00	2.78	3.57	7.13	12.00
Strip Cruise Data											
Beaver Crossing	16	8.0	14	35	175.63	138.13	33.12	4.38	30.00	25.62	4.38
Little Spearfish Creek	16	8.0	57	283	118.75	65.00	53.12	1.88	0.63	-	0.62
Little Spearfish Spring	19	9.0	25	47	119.47	105.79	1.58	1.05	1.25	7.50	12.11
Total	51	25.0	96	366							
Average					136.85	103.14	27.65	2.35	13.53	11.37	6.08
District Total	166	91.3	286	667							
District Average					126.87	98.47	13.19	2.65	6.63	8.43	10.18
FOREST TOTAL	518	274.2	978	1,333							
FOREST AVERAGE					112.04	90.38	13.61	3.78	4.32	5.21	8.05
Build-up Ratio 1976 : 1977				1 : 0.73							

TABLE 2 SUMMARY OF STRIP CRUISE LINES AND PHOTO SURVEY BY AVERAGE DBH

Area [1]	All Trees	All Pine	Live Pine	Dead Pine	MPB Infested Pines			Dead Pine Other Causes	Spruce	Aspen	Birch	Oak
					1977	1976	Older					
A	9.86	9.99	9.86	12.12	12.00	11.82	11.78	31.00	-	6.44	-	-
B	11.84	11.84	11.69	15.53	15.64	15.20	16.00	-	-	-	-	-
C	9.70	9.70	9.65	10.74	11.15	13.99	14.43	6.00	-	-	-	-
D	10.47	11.14	11.02	11.80	13.29	10.56	11.98	-	-	7.47	-	-
E	9.16	9.41	9.30	9.91	10.58	9.35	10.78	6.00	-	6.02	5.00	-
F	8.91	8.92	8.56	9.42	10.83	9.60	9.54	5.00	-	8.00	-	-
G	8.70	8.78	8.75	11.00	11.00	11.00	-	-	13.23	7.68	-	-
H	8.35	8.35	8.28	8.80	9.37	8.44	8.42	-	-	-	-	-
J	8.28	8.26	8.19	9.99	17.00	8.29	17.50	10.93	9.72	-	-	-
K	8.76	8.84	9.02	8.34	7.05	9.41	9.98	-	10.31	-	-	6.21
L	10.18	10.91	10.68	13.88	14.23	13.77	-	-	7.98	6.00	-	-
M	8.28	8.40	8.13	9.48	8.76	10.53	9.75	-	8.21	7.10	-	-
N	9.85	9.85	9.18	10.87	10.31	11.11	11.46	-	-	-	-	-
Strip Cruise Average	9.11	9.23	9.13	9.75	9.26	10.04	10.10	6.35	10.03	7.12	5.00	6.21
Photo Plot Average	8.27	8.63	8.59	9.19	10.39	11.49	8.86	6.33	8.63	6.03	5.77	7.17
Forest Average	8.41	8.73	8.68	9.33	10.07	10.89	9.09	6.33	8.72	6.19	5.74	7.03

[1] Letter designations are for strip cruise lines. See Table 4 and map for location and names.

TABLE 3 SUMMARY OF STRIP CRUISE LINES AND PHOTO SURVEY BY STAND COMPOSITION (PERCENT)

Area [1]	Total Stand (Live and Dead Trees)							Live Trees		Pine Mortality [2]	
	All Pine	Live Pine	Dead Pine	MPB Infested Pines			Non-host Trees	Pine	Non-host Trees	Stand Composition	Basal Area
				1977	1976	Older					
A	96.41	90.81	5.60	0.55	2.27	2.68	3.59	96.19	3.81	5.81	7.75
B	100.00	96.26	3.74	2.37	1.04	0.33	-	100.00	-	3.74	5.94
C	100.00	94.74	5.26	2.37	0.81	0.75	-	100.00	-	5.26	6.50
D	81.76	69.34	12.42	1.64	3.12	7.66	18.24	79.17	20.83	15.19	16.46
E	93.44	76.78	16.66	1.91	7.02	6.87	6.56	92.12	7.89	17.83	19.34
F	99.30	58.43	40.87	1.15	22.45	15.60	0.70	98.82	1.18	41.16	44.97
G	89.45	88.62	0.83	0.55	0.28	-	10.55	89.37	10.63	0.93	1.47
H	100.00	86.71	13.29	5.27	1.01	7.01	-	100.00	-	13.29	12.86
J	98.51	94.73	3.78	0.18	2.56	0.37	1.49	98.45	1.55	3.84	5.73
K	94.84	70.79	24.04	11.47	10.07	2.50	5.16	93.20	6.80	25.35	22.58
L	76.51	71.88	5.63	1.32	4.31	-	23.49	76.17	23.83	7.36	10.74
M	82.58	65.90	16.67	7.53	3.85	5.29	17.42	79.09	20.91	20.18	25.00
N	100.00	60.11	39.89	14.18	21.34	4.37	-	100.00	-	39.89	45.33
Strip Cruise Average	93.22	78.38	14.84	3.91	5.88	5.48	6.78	92.02	7.98	15.92	16.40
Photo Plot Average	88.02	79.79	8.23	1.73	1.39	3.69	12.98	86.78	13.22	9.35	10.54
Forest Average	88.80	79.62	9.18	2.27	2.43	4.38	11.20	87.61	12.29	10.34	13.09

[1] Letter designations are for strip cruise lines. See Table 4 and map for location and name.

[2] Percent of all Pine Live and Dead.

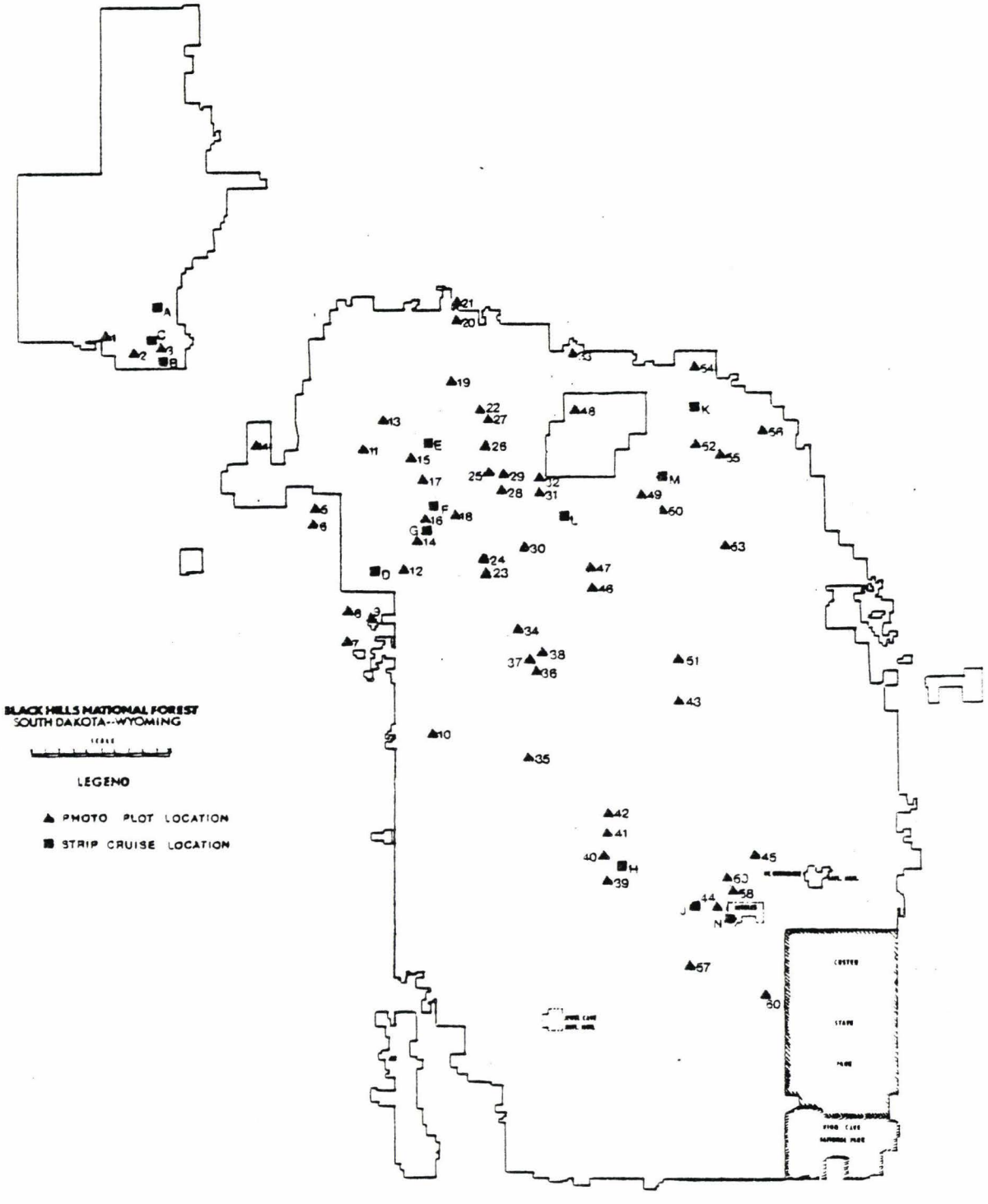
TABLE 4 PHOTO PLOT AND STRIP CRUISE LOCATIONS

MAP LOCATION SYMBOL	PHOTO PLOT NUMBER	DISTRICT	AREA LOCATION - NAME
1	2 - 2	Bearlodge	Warren Peaks
2	4 - 1	"	Ragged Top
3	5 - 1	"	Tent Canyon
4	9 - 1	"	Boarding House Creek
5	11 - 3	"	Deer Creek
6	11 - 4	"	Moskee
7	12 - 1	Elk Mt.	Soldier Creek
8	12 - 2	"	Barnett Draw
9	13 - 3	"	Cold Springs Creek
10	15 - 2	"	Bear Springs
11	13 - 8	Spearfish	Rattlesnake Canyon
12	14 - 5	"	Grand Canyon
13	14 - 7	"	Cement Ridge
14	15 - 5	"	Little Spearfish Spring
15	15 - 7	"	Little Spearfish Canyon
16	16 - 2	"	Intake Gulch
17	16 - 5	"	Little Spearfish Creek
18	17 - 5	"	Dead Ox Creek
19	17 - 7	"	Tollgate Flats
20	17 - 9	"	Crow Peak South
21	17 - 10	"	Crow Peak North
22	18 - 1	"	Iron Creek West
23	19 - 5	"	Clayton Draw
24	19 - 6	"	Merow Spring
25	19 - 8	"	Timber Gulch South
26	19 - 9	"	Timber Gulch North
27	19 - 12	"	Iron Creek East
28	20 - 1	"	Hellsgate Gulch
29	20 - 2	"	Elmore
30	21 - 8	"	Well Park
31	23 - 16	"	Ice Box Gulch
32	23 - 17	"	Raspberry Gulch
33	25 - 11	"	Tetro Creek
34	19 - 4	Harney	Crooks Lake
35	21 - 2	"	Trail Draw Fork
36	21 - 5	"	Rhoads Spring
37	21 - 6	"	Rhoads Fork
38	23 - 9	"	Whitetail Peak
39	27 - 5	"	Stan-Penn Lode
40	27 - 6	"	Long Draw

TABLE 4 (continued)

MAP LOCATION SYMBOL	PHOTO PLOT NUMBER	DISTRICT	AREA LOCATION - NAME
41	27 - 8	Harney	Copper Mountain
42	27 - 9	"	Slate School
43	32 - 4	"	Castle Creek
44	35 - 3	"	Sylvan Lake
45	37 - 5	"	Palmer Creek North
46	25 - 4	Nemo	Sweede Gulch
47	25 - 5	"	Dumont
48	29 - 8	"	Sheeptail Creek
49	30 - 1	"	Bear Butte Creek West
50	31 - 4	"	Roubaix
51	32 - 5	"	Gimlet Creek
52	33 - 1	"	Bear Butte Creek East
53	34 - 2	"	Lucky Strike Mine
54	34 - 7	"	Boulder Park
55	35 - 4	"	Kirk Hill
56	36 - 7	"	Vanocker Creek
57	32 - 1	Custer	Tenderfoot Gulch
58	36 - 3	"	Harney Peak
59	36 - 4	"	Palmer Creek South
60	37 - 1	"	Stockade Lake
A		Bearlodge	Bull Hill
B		"	Tent Canyon I
C		"	Tent Canyon II
D		Elk Mt.	Deer Creek
E		Spearfish	Beaver Crossing
F		"	Little Spearfish Creek
G		"	Little Spearfish Spring
H		Harney	Bobcat Gulch
J		"	Spring Creek
K		Nemo	Boulder Park
L		"	East Spearfish Creek
M		"	Strawberry Ridge
N		Custer	Needles

FIGURE 1


BLACK HILLS NATIONAL FOREST
SOUTH DAKOTA--WYOMING
LEGEND
PHOTO PLOT LOCATION
STRIP CRUISE LOCATION